UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

Captain Marc Delao
Regional Engineer
Navy Region Hawaii
850 Ticonderoga St. STE 110
Joint Base Pearl Harbor Hickam, Hawaii 96860

Re: Approval to revise schedule for deliverables 6.3- Investigation and Remediation of Releases Report and 7.1.3. - Groundwater Flow Model Report of the Red Hill Administrative Order on Consent ("AOC") Statement of Work ("SOW") and Comments on Interim Environmental Reports

Dear Captain Delao:

The U.S. Environmental Protection Agency ("EPA") and Hawaii Department of Health ("DOH"), collectively the "Regulatory Agencies", have received the U.S. Department of Navy's ("Navy's") letter dated October 12, 2018, and approve the Navy's request for a ten-month extension to the Red Hill AOC SOW (the "AOC") Sections 6.3 and 7.1.3 for the purpose of improving the quality of those deliverables. The Regulatory Agencies fully expect the Navy to utilize this extension to correct the deficiencies in the conceptual site model ("CSM") and groundwater flow model ("GFM") outlined in this letter and explained more fully in the enclosures. The CSM, GFM and other environmental work under the AOC was designed to inform ongoing and future planning decisions, and may be particularly relevant to those decisions related to AOC section 3 – Tank Upgrade Alternatives. The TUA Decision Document pursuant to this section, is due to be submitted later this year, To the extent that the TUA Decision Document relies upon conclusions drawn from the substance of any of the environmental work being performed pursuant to other sections of the AOC, the quality of the TUA decision will necessarily be dependent on the quality of the underlying environmental work, or lack thereof, used to support that decision.

The Regulatory Agencies reviewed the *Groundwater Protection and Evaluation Considerations for the Red Hill Bulk Fuel Storage Facility* (dated July 27, 2018) and *Conceptual Site Model, Investigation and Remediation of Releases and Groundwater Protection and Evaluation, Red*

Hill Bulk Fuel Storage Facility (dated July 27, 2018) developed by the Navy and its contractors. These interim documents detail the Navy's comprehensive understanding of the conceptual site model representing the Red Hill Bulk Fuel Storage Facility ("Facility") and the surrounding environment, as well as a preliminary model of local and regional groundwater flow.

The Regulatory Agencies continue to believe that some of the interpretations and determinations made in the interim documents are premature or inappropriate after reviewing the supporting data and conducting independent analyses. During in-person meetings of August 14- 16, 2018, the Regulatory Agencies' consultants gave a presentation on issues of concern related to the interim information that had been made available at that time. We also acknowledge that the Navy has collected and compiled significant quality data for this effort, and the Navy's efforts continue to improve in this regard.

As summarized below, the Navy should use this extension to address several key aspects of the ongoing environmental investigation and interpretation work. Supporting materials developed by the Regulatory Agencies' consultants and subject matter experts are provided in the enclosure attached to this letter. As expanded upon more fully in the enclosures, the ten issues of greatest concern can be generally described as relating to the CSM, GFM and Fate and Transport.

Concerns with the Interim CSM

The CSM should explain all observed data in the field to the extent possible and data that are not incorporated into the model, even if qualified, should be thoughtfully considered. Conceptual and numerical models that best fit available data are critical for technical defensibility of the application of the model to evaluate flow paths and contaminant fate. In particular, the Regulatory Agencies continue to have concerns with the following aspects of the CSM:

1) Predominant strike and dip of basalt in the geologic model- The direction and magnitude as represented by the Navy thus far do not agree with the lava flow geometry independently evaluated by the Regulatory Agencies and provided to the Navy. This information is important because it will influence Navy's conclusions regarding groundwater flow paths and transport.

2) Saprolite extent in the interim model vs. depths inferred by seismic profiling- The extent of the modeled saprolite/basalt interface depths do not agree with the seismic profiling. In particular, the seismic profiling indicates that the saprolite layer depth in the upper reaches of the Halawa Valleys constitutes a much less protective barrier to northwest groundwater flow than the GFM indicates. This directly impacts the evaluation of risk to the Halawa Shaft.

3) Preferential pathways- The consideration and methods of incorporation of preferential pathways in both the CSM and the groundwater model are unclear. Although it is impracticable to precisely characterize these features, the influence that geologic structures, such as voids, fractures, lava tubes, and the permeable interface between lava flows, have on contaminant and groundwater transport should be explained conceptually in the CSM. The influence of these structures should also be incorporated into the GFM using appropriate and traceable mathematical representations. This directly impacts the Navy's ability to evaluate contaminant transport in the vadose zone and in the groundwater.

Concerns with the interim GFM

Outputs from the GFM do not comport with measured groundwater gradients in terms of their magnitude, direction, and variability. Several lines of evidence – including measured water levels, organic and inorganic water quality sampling results – suggest occasional gradients, groundwater flow and contaminant migration toward the northwest from tanks located further up the ridge at the Facility. The Navy should address the following aspects of the GFM:

4) Representation of caprock, tuffs and sediments- These features are present in the Navy's narrative of the CSM but are not all incorporated within the interim GFM in a manner consistent with the CSM. Additional evaluation of how these features may affect gradients, groundwater flows, and transport, should be completed.

5) Drinking water shaft inflows- The GFM does not reproduce the documented distribution of inflows into the Red Hill drinking water shaft and tunnel system. Giving further consideration to conditions observed in Red Hill shaft may improve overall model calibration and reliability in the vicinity and downgradient of the facility.

6) Calibration to groundwater heads and gradients- The GFM does not closely reproduce measured heads and gradients. The final model should prioritize use of the best available groundwater level data reflecting the range of hydraulic gradients under reasonable pumping and non-pumping conditions.

7) Coastal marine boundary and discharge- The coastal discharge rates and patterns in the final GFM should be discussed with the groundwater modeling subject matter experts, as the over-determination of this boundary condition may reduce model sensitivity to other parameter changes.

Concerns with interim work related to Fate and Transport

The *Contaminant Fate and Transport Model Report* required by Red Hill AOC Statement of Work is not due until 180 days after the approval of the *GFM Report* and the *Investigation and Remediation of Releases Report*. Therefore, a *Contaminant Fate and Transport Report* is not anticipated to be completed until the middle of 2020 after our approval of this extension request. As a result, we are providing comments for your consideration in the CSM development and the Navy's longer-term development of the *Contaminant Fate and Transport Model Report*. In the short term, we expect conservative contaminant fate and transport considerations to be discussed as a component of the Navy's upcoming tank upgrade proposal at Red Hill.

The Navy's current CSM and statistical Non-Aqueous Phase Liquid ("NAPL") holding model do not adequately address potential impacts to groundwater from fuel releases, account for Light Non-Aqueous Phase Liquid ("LNAPL") migration processes, or explain lines of evidence for historical transport observed in the field. Although local characterization data indicates that substantial natural attenuation of hydrocarbons may be occurring, field characterization of the subsurface is highly challenging and impractical in some areas near and around the tanks at the Facility. Therefore, conservative assumptions bounding NAPL fate and transport or robust, dynamic fate and transport models are critical for long term environmental stewardship. The Navy should address the following issues:

8) Light Non-Aqueous Phase Liquid ("LNAPL") fate and transport- The CSM for LNAPL transport needs to more broadly consider potential rates, directions and distances of LNAPL

transport and the primary features and processes affecting that potential transport. The Navy should present the Regulatory Agencies with an approach for developing modeling of LNAPL fate and transport in this environmental setting. The final model should consider potential rates and directions of transport as a function of different types of releases, provide source terms to determine if releases can be captured through pumping, model cumulative effects of releases over time, and utilize incoming field results and new information to calibrate model outputs to observed conditions.

9) Groundwater data- Interpretations of groundwater data from before and following the time of the 2014 release do not adequately consider limited data density and the range of plausible interpretations, including the probability of northerly contaminant transport. Additionally, general water quality indicators including nitrate and dissolved oxygen should be closely examined as lines of evidence for transport and attenuation of past releases.

10) LNAPL and dissolved-phase distribution - The CSM presumes a specific distribution of LNAPL as an outcome of the 2014 release (and prior historical releases), without sufficient data to support this presumption (i.e., the Regulatory Agencies do not view the thermal profile interpretation as definitive). Vapor monitoring data from the time immediately following the release, as well as other historical data suggests other distributions may be possible. Based on the data that are currently available, the Regulatory Agencies believe that a range of possible LNAPL distributions is plausible and the Navy should more closely examine the data and consider the plausible range of migration pathways and timeframes.

Recommended Schedule for Navy's Extension

The Regulatory Agencies recommend the following schedule to address the issues detailed above. We anticipate that the Navy may want to provide additional opportunities for focused technical discussion remotely or in person, as needed. The Navy should also consider appropriate avenues and times for engaging external Subject Matter Experts.

Recommended Schedule for Navy Extension	
Date	**Task**
November 2018	Kickoff Meeting with Agencies
November – March 2019	Data Evaluation, CSM Updates and GFM, Fate and Transport (F&T) Updates
April 2019	Review with Regulatory Agencies and Subject Matter Experts, Updates to the CSM, Interim GFM, and F&T
May – June 2019	Continue GFM Updates and Predictive Simulations
July 2019	Presentation of Draft Deliverable to Subject Matter Experts
October 2019	Final Section 6.3 and 7.1.3 Deliverable Submittals

Response Requested

The Regulatory Agencies concur with the Navy that the deliverables required per Section 6.3 and 7.1 of the Red Hill AOC SOW shall be submitted to us no later than October 5, 2019. The Regulatory Agencies require that the Navy respond to this letter via letter or email by November 16, 2018 with a proposed schedule over the course of the extension and to confirm receipt of this

extension approval. The Navy's schedule should include dates where it expects to seek agreement with the Regulatory Agencies on key issues prior to submitting the final deliverables.

Accounting for NAPL effects on groundwater and drinking water resources is important for the upcoming tank upgrade proposal and we would like to engage the Navy and its consultants in further discussion to resolve outstanding issues regarding NAPL fate and transport. The Regulatory Agencies also encourage the Navy to concurrently continue its efforts to install more groundwater monitoring wells to further improve its modeling efforts. We look forward to your response to this letter and the upcoming environmental work required as part of the AOC. Please let us know if you have any comments or concerns with the information in this letter.

Sincerely,

Omer Shalev
Project Coordinator
EPA Region 9 Land Division

Roxanne Kwan
Interim Project Coordinator
DOH Solid and Hazardous Waste Branch

Enclosures: Attachment 1- Navy letter to EPA Region 9 and DOH dated October 12, 2018
Attachment 2- Conceptual Site Model Topics
Attachment 3- Interim GFM
Attachment 4- Interim Fate and Transport Analyses
Attachment 5- Presentation Slideshow from August 2018

cc: Mr. Mark Manfredi, Navy (via email)
Mr. Aaron Poentis, Navy (via email)
Mr. Cory Waki, Navy (via email)